WE CLAIM:

1. A method for performing an integrated diagnostics of an EMA motoring subsystem using embedded electronic control circuits, the method comprising:

implementing a plurality of operating structures into an EMA motoring subsystem, each operating structure having optimized rates of data sampling and processing ;

determining an operational mode of the EMA motoring subsystem;

selecting one of the implemented plurality of operating structures that corresponds to the determined operational mode;

acquiring multi-channel data using the selected operating structure; and

analyzing the acquired data to identify and classify a fault of the EMA motoring subsystem.

2. A method of variable structure diagnostics system, comprising:

implementing a plurality of operating structures into an EMA motoring subsystem, each operating structure having optimized rates of data sampling and processing ;

determining an operational mode of the EMA motoring subsystem;

selecting one of the implemented plurality of operating structures that corresponds to the determined operational mode;

acquiring multi-channel data using the selected operating structure; and

analyzing the acquired data to identify and classify a fault of the EMA motoring subsystem.

3. The method of claim 2, wherein the determined preferred operational mode of a low sampling frequency is a pseudo-small-signal mode.

4. The method of claim 2, wherein the determined operational mode is a large signal mode in complementary to the pseudo-small-signal mode.

5. The method of claim 2 identifies the vehicle mission states combining with the estimation of the pseudo-small-signal mode, further reducing the rate of the data sampling and processing.

6. A method for performing integrated diagnostics of an EMA motoring subsystem in a flying vehicle at a low-frequency sampling rate, the method comprising:

determining a mission phase of an operating vehicle;

selecting a pseudo-steady-state operating condition of an EMA motoring subsystem of the operating vehicle based on the determined mission phase;

sampling and processing data at a low-frequency sampling rate optimized for the selected pseudo-steady-state operating condition; and

identifying and classifying a fault of the EMA motoring subsystem based on the processed data.

7. The method of claim 6, wherein the determined mission phase is on-ground, take-off, cruise or landing phase.

8. The method of claim 6, further including the step of:

predicting the fault of the EMA motoring subsystem based on the processed data.

9. The method of claim 6, wherein the operating vehicle is an Unmanned Combat Air Vehicle (UCAV), a shuttle evolved vehicle or new manned space vehicle, a commercial aircraft, a land based autonomous craft, a

land based manned craft, a sea based autonomous craft or a sea based manned craft.

10. A method for identifying a pseudo-steady-state operating condition of an EMA motoring subsystem in a system, comprising:

determining a mission phase of a system;

assessing at least one key state variable of an EMA motoring subsystem in the system; and

identifying a pseudo-steady-state operating condition of the EMA motoring subsystem based on the determined mission phase combined with the assessed at least one key state variable.

11. The method of claim 10, wherein the determined mission phase is on-ground, take-off, cruise or landing phase.

12. The method of claim 10, wherein the assessed at least one key state variable is position of a ball screw ram, motor position, motor phase current, motor input current, motor bridge current, motor pulse-width-modulation amplitude, motor supply voltage or actuator position.

13. The method of claim 10, wherein the identified pseudo-steady-state operating condition is on-ground, take-off, cruise or landing condition.

14. A method for performing integrated diagnostics and prognostics of an EMA motoring subsystem in a vehicle, the method comprising:

monitoring an operational status of an EMA motoring subsystem of a vehicle;

determining an operational mode of the EMA motoring subsystem based on key state variables of the EMA motoring subsystem and a mission phase of the vehicle;

selecting sampling rate optimized for the determined operational mode;

acquiring multi-channel data at the selected sampling rate;

storing the acquired data to a memory through a DMA channel;

analyzing condition of the EMA motoring subsystem using the stored data;

identifying and classifying a fault of the EMA motoring subsystem based on the analyzed condition; and

predicting the fault of the EMA motoring subsystem based on the analyzed condition.

15. A method of claim 14, wherein the determined operational mode is a pseudo-small-signal mode or a large signal mode.

16. A method of claim 14, wherein the selected sampling rate is an optimum sampling rate for the large signal mode.

17. A method of claim 14, wherein the EMA motoring subsystem is a stator winding, a rotor bar or a bearing system.

18. A method for performing integrated diagnostics and prognostics of an EMA motoring subsystem in a vehicle, the method comprising:

implementing a plurality of operating structures into an EMA motoring subsystem of a vehicle, each operating structure having a data sampling rate;

monitoring an operational status of the EMA motoring subsystem;

determining a flight mission phase of the vehicle;

assessing key state variables of the EMA motoring subsystem;

selecting one of the plurality of operating structures based on assessed key state variables and the determined flight mission phase;

acquiring multi-channel data using the selected operating structure;

storing the acquired data to a memory through a DMA channel;

analyzing condition of the EMA motoring subsystem using the stored data;

identifying and classifying a fault of the EMA motoring subsystem based on the analyzed condition; and

predicting the fault of the EMA motoring subsystem based on the analyzed condition.

19. An EMA motoring subsystem, comprising:

an EMA;

at least one motor for driving the EMA; and

power controls for operating the at least one motor, the power controls including a DSP controller for sampling and processing data at a plurality of sampling rates.

20. The EMA motoring subsystem of claim 19, wherein one of the plurality of sampling rates is optimized for a large signal mode.

21. The EMA motoring subsystem of claim 19, wherein one of the plurality of sampling rates is optimized for a pseudo-small-signal mode.

22. The EMA motoring subsystem of claim 21, wherein the pseudo-small-signal mode is on-ground, take-off, cruise or landing mode.

23. The EMA motoring subsystem of claim 19, wherein the at least one motor is a BLDC motor.

24. An EMA motoring subsystem, comprising:

a gearbox having a plurality of gears;

a ball screw ram for transforming rotary motion of the plurality of gears into linear displacement;

at least one motor for driving the plurality of gears; and

power controls for operating at least one motor, the power controls including a DSP controller for sampling and processing data at a plurality of sampling rates.

25. The EMA motoring subsystem of claim 24, wherein the DSP controller is connected to a vehicle management computer that analyzes the data processed by the DSP controller to increase confidence level of the data and provides the DSP controller with information to support the DSP controller's selection of monitoring mode.

26. The EMA motoring subsystem of claim 25, wherein the vehicle management computer is connected to a control system and sends the data to the control system.

27. The EMA motoring subsystem of claim 25, wherein the vehicle management computer is connected to a GUI that demonstrates and tests the EMA motoring subsystem.

28. A flying vehicle comprising:

at least one EMA motoring subsystem comprising:

an EMA;

at least one motor for driving the EMA; and

power controls for operating the at least one motor, the power controls including a DSP controller for sampling and processing data at a plurality of sampling rates.

29. The flying vehicle of claim 28, further comprising:

a vehicle management computer for analyzing the data processed by the DSP controller to increase confidence level of the data and providing the DSP controller with information to support the DSP controller's selection of monitoring mode, said vehicle management computer connected to the DSP controller.

30. The flying vehicle of claim 29, further comprising:

a GUI for demonstrating and testing the at least one EMA motoring subsystem, said GUI connected to the vehicle management computer.

31. The flying vehicle of claim 29, further comprising:

a control system for exploiting the data from the vehicle management computer to control the flying vehicle, said control system connected to the vehicle management computer.

32. A vehicle comprising:

at least one EMA motoring subsystem comprising:

a gearbox having a plurality of gears;

a ball screw ram for transforming rotary motion of the plurality of gears into linear displacement;

at least one motor for driving the plurality of gears; and

power controls for operating the at least one motor, the power controls including a DSP controller for sampling and processing data at a plurality of sampling rates;

a control system;

a GUI for demonstrating and testing the at least one EMA motoring subsystem; and

a vehicle management computer for analyzing the data processed by the DSP controller to increase confidence level of the data, providing the DSP controller with information to support the DSP controller's selection of monitoring mode and sending the data to the flight control system, said vehicle management computer connected to the DSP controller, the GUI and the control system.